IMPLEMENTATION OF THE RESOURCES PLANNING ACT:

A Suggested Approach, A Critique of Current Progress, and an Evaluation of ECOSYM as an Information Management System That Could be Used

by

Lawrence S. Davis

May 1978

Logan, Utah

Final report for Supplement 37,
Contract 11-11-008-876, South-
eastern Forest Experiment
Station, USFS

Also contributing:

Kenneth Ware
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U. S. FOREST SERVICE

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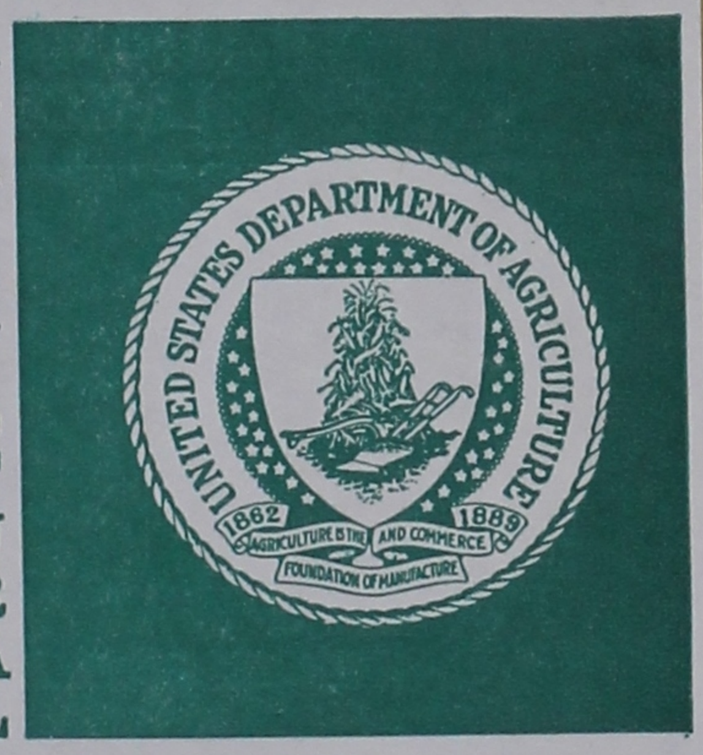

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EXECUTIVE SUMMARY

This report is concerned with implementation of the Resources Planning Act. First suggested analytical concepts and a procedural model are presented. Then current progress in implementation is reviewed. Finally ECOSYM is evaluated as a land classification and information management approach for forest level assessment and planning.

Some key findings are:

Concepts and Procedures

1. Assessment, conceptually, should be the process of generating feasible program options.

2. Assessment of the resource base needs to be done at the forest level using in-place data to ensure program feasibility.

3. The relation of "Assessment and Program" to "Planning and Plans" needs to be clearly drawn. Conceptually and functionally they are much the same thing.

Critique of Progress Towards the 1980 Assessment (based on the March 1978 Progress Report).

1. Feasibility - the ability to deliver recommended national programs - is not adequately handled.

2. The five program directions do not seem to represent any particular range of goals or issues and do not present real choices . . . i.e., alternative output mixes at a given budget level.

3. The range of possible output mixes suggested in the target graphs seems biologically, economically and politically unrealistic.

4. Assessment and programs are not clearly linked.

Evaluation of ECOSYM

1. Logically, ECOSYM is consistent with most forest level assessment and planning needs as envisioned under RPA. It is also consistent with the proposed NFMA planning regulations.

2. A panel of system analyists familiar with the USFS and the RPA/NFMA found ECOSYM to provide a solid framework for an in-place information system and supportive of many important analytical and planning activities. It does need forest-wide testing to examine real costs and operability.

3. Initial test area applications and demonstrations of ECOSYM to National Forest staff finds it technically feasible. It can be implemented, costs are not prohibitive and forest staff are receptive. Trial operational applications on the Uinta and Manti-LaSal National Forests will provide more concrete data by 1979.

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INTRODUCTION

This report covers three separate but related efforts in which I have been involved concerning the Resources Planning Act (RPA) as amended by the National Forest Management Act (NFMA). The first is an effort to formulate useful analytical and procedural concepts for implementation of the Acts. The second is a specific critique of material presented in the document; The Resources Planning Act: A Progress Report, released in March, 1978 with the request for review comments. The third is an evaluation of ECOSYM[1] for suitability as an information management system for assessment, program formulation and forest planning needs. This evaluation of ECOSYM is specifically called for by cooperative agreement between the southeastern station, USFS, and the University of Georgia. This report serves as a final report for that project.

The analytical model for implementing the RPA presented in the first part of this report serves as the standard both for my critique of the March 1978 RPA progress report and for my evaluation of ECOSYM. The model itself has undergone considerable evolution. It germinated with the work of the ad hoc committees to prepare material on scientific information and data needs for the 1975 assessment (Ken Ware, G. Elsner, M. Penfold, E. Valfer, R. Whaley and L. Davis.) It was developed

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[1] ECOSYM is a comprehensive approach to wildland resource information management developed at Utah State University. It includes specific set of procedures for land classification and mapping, concepts and examples of how this basic data can be objectively used and interpreted and a suggested software system (CONGRID) which is consistent with the ECOSYM approach.

further in the Utah State University seminar report for the Parejo Dunes University Symposium reviewing the 1975 assessment in the spring of 1976. Hopefully, at this writing most of the poor ideas have been discarded and it will provide a useful conceptual framework.

ANALYTICAL CONCEPTS FOR ASSESSMENT AND PROGRAM

One main objective of this report is to consider land classification and information systems with respect to their use in assessment and program formulation by the U. S. Forest Service. To do this, a model of how assessment and program works (or should work) is needed.

The model presented below is based on analysis of the legislation, experience with the 1975 assessment, a review of the 1977 RPA progress report, reading of the April 11, 1978 draft planning rules and the Utah State research[2] about how an information system might most effectively function. This model does not correspond directly to the procedures followed in 1975 and proposed in the 1980 assessment. Rather its my conceptualization of how it might work by 1990 and beyond. As such, it serves as a basis to critique the 1980 procedures as reported in the RPA progress report.

Definitions

Given that the wildlands of the U. S. are distributed into these ownership categories:

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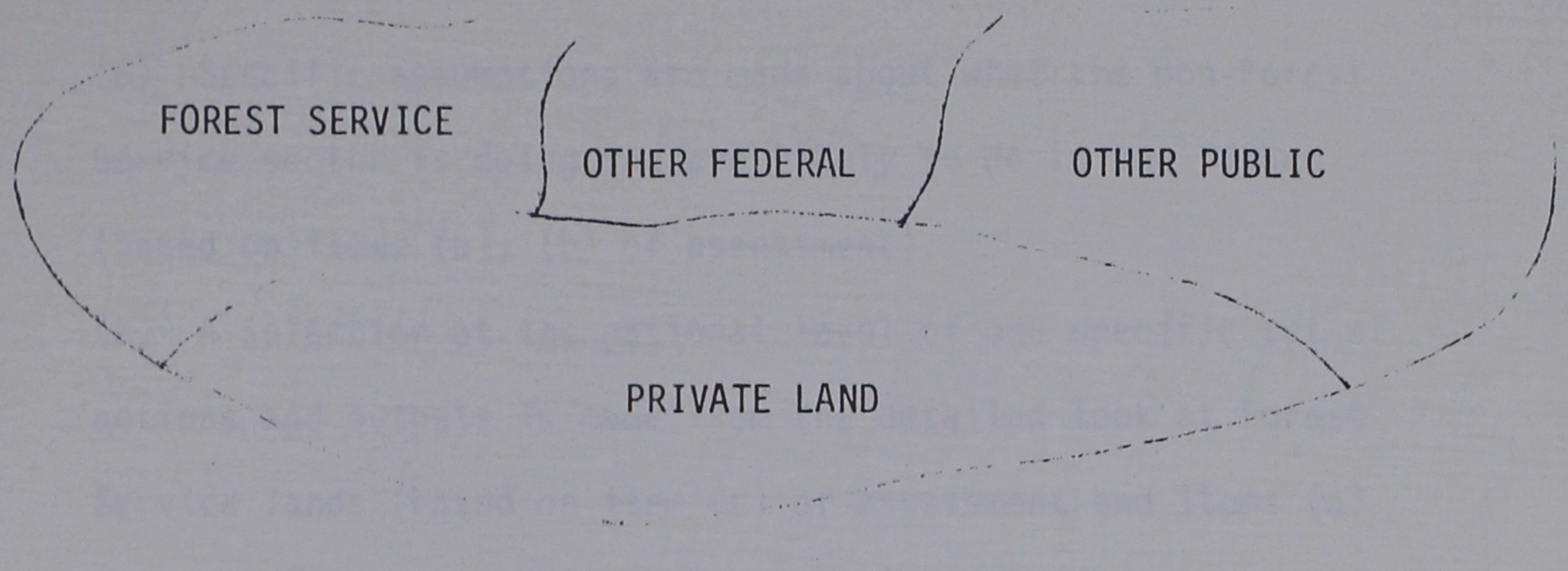
[2]The Utah State research is sponsored by the U. S. Forest Service through the Surface Environment and Mining Program (SEAM), Billings, Montana.



The following five terms are used in the models and discussion that follows:

1. Assessment Guides: Directions originating from the national level, as to the budget assumptions new output emphasis or targets desired changes from the last program, emerging issues and any other constraints appropriate to define feasibility of options at the forest level.

2. Assessment:

   (a) a general stock taking of land and resource distribution, current production levels and production potentials for all 1.8 billion acres of wildlands in the U. S.

   (b) predictions of what all non-Forest Service land owners are likely to do in the future under different future conditions of price, markets, policy, population, etc.

   (c) A detailed analysis of the resources, current outputs and the formulation of feasible alternative output mixes (program options) from Forest Service land.

3. Program:

   (a) An identification of national renewable resource goals and

needs.

(b) Specific assumptions are made about what the non-Forest Service sector is doing and are likely to do in the future (based on items (a), (b) of assessment).

(c) A selection at the national level of one specific set of actions and outputs is made from the detailed look at Forest Service lands (based on item (c) of assessment and items (a) and (b) of the program).

(d) The chosen set of actions and expected outputs is converted to a specific Forest Service program and budget for recommendation to Congress.

4. Implementation:

(a) The legislatively approved program corresponding to appropriate budgets is disaggregated to the region and thence to the forest. The selected program is actually implemented on the ground as originally scheduled in the forest level assessment.

5. Monitoring:

(a) Post-treatment observations on (1) the portion of scheduled treatments and acreage reallocations which were actually completed and the corresponding output responses which are actually realized.

(b) The reporting and aggregation of output responses from forest to National level to guide subsequent assessment and pro gram cycles.

These steps of Assessment Guides, Assessment, Program Implementation and Monitoring can be viewed as a logical and orderly sequence of events followed at decade intervals as required by the RPA. Each step requires a process of disaggregation or aggregation. The assessment and program for NFS lands is separated from but related to assessment of non-NFS lands and developed of state and private programs.

A key characteristic of the model presented here is that all inventory, analysis and evaluation of the resource base is confined to the lowest level of assessment. Consequently, all aggregation of information upward from the forest is by outputs and output responses. This means that the forest would not say "we have x acres of z site productivity" but rather, "given the resources of this forest, we currently produce (x) mmbf of timber for sale and under program option A we could feasibly increase timber outputs by (y) mmbf per year over the next decade."

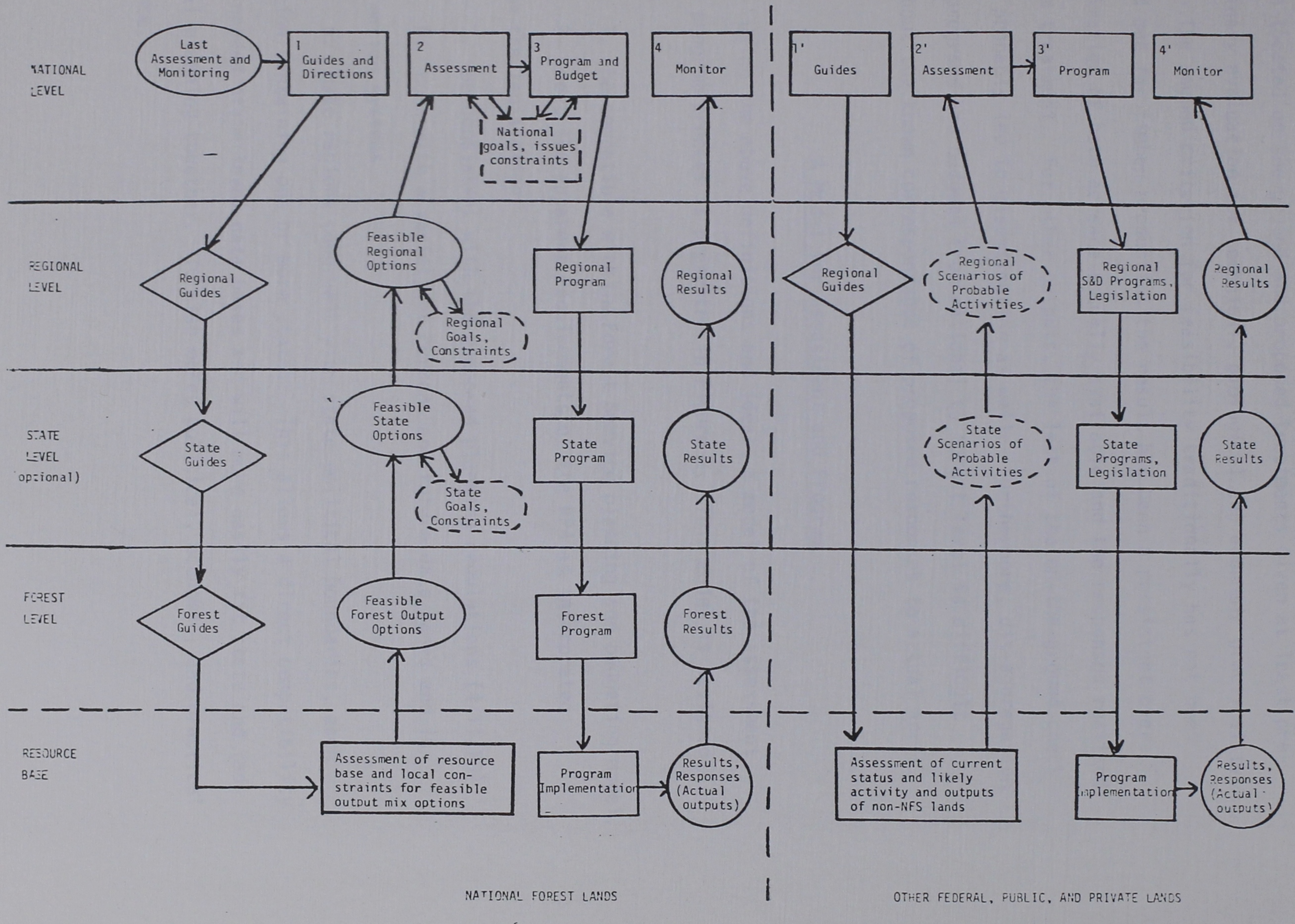
The results of the forest level assessment, then, is an identication of its current output levels and a description of several feasible program options (changes in the output mixes) that could be practically achieved with different budgets and program emphasis -- such a summary might appear as in Figure 1. The first set of options are the 'feasible' ones for actual consideration and the second set, which are not constrained by budget, could be presented to suggest biological potentials is that was desired.

It is important to understand the 'feasibility' concept used here. While the forest states its program options in summary form (as in Figure 1), it assumed that the projected output responses of each option can, in fact, be delivered. This, in turn means that (1) all forest budget, legal and policy constraints are met and (2) all the acres to be treated and/or re-allocated to produce different output mixes have

Figure 1. Assessment Summary Presenting Feasible Program Options at Forest, State and Regional Levels -- hypothetical numbers are for illustration.

ITEM	CURRENT PROGRAM	CONSTRAINED FEASIBLE OPTIONS FOR NEXT DECADE		UNCONSTRAINED OPTIONS (TO INDICATE BIOPHYSICAL POTENTIAL)		
		A	B C . . .	A*	B*	C* . . .
OUTPUT		-- changes	from current program --	-- changes	from current	program --
Timber	10 MMBf	+2 MM	+5 MM	+10 MM	-2 MM	. .
Forage	5 M AUM	-1 M	+2 MM	--	+4 M	. .
Type A Recreation	30,000 UD	-2000	no change	--	--	. .
Type B Recreation	5,000 UD	no change	no change	--	--	. .
.	.	.		.	.	.
.	.	.		.	.	.
.	.	.		.	.	.
COSTS						
Capital	$3.7 MM	+0	+100 M/yr	+1.2 MM	+.75 MM	. .
Annual Operating Budget	$1.2 MM	+0	+50 M/yr	+200 M	+10 M	. .

Figure 2. Model for Assessment and Program



been located on the ground and proposed treatments given at least preliminary evaluation for technical, biological and economic practicality.

The second criterion for feasibility traditionally has not been used and for timber production the result has been a persistent overestimation of both acreage actually available and the responses realized from treatment. For other outputs, the lack of the on-the-ground check has probably led to misestimation as well. Furthermore, dis-aggregation of programs and budgets from national to forest level is difficult without the known correspondence of proposed responses to actual acres.

A Model for Assessment and Program

Using the above definitions and ideas, a model of the assessment and program process is presented in Figure 2. This model is designed to:

1. be compatible with the Forest Service planning and budgeting model.
2. meet the apparent requirements of the RPA as interpreted from the legislation.
3. be consistent with the proposed planning regulations (4/11/78).
4. work with a variety of current and future data bases and information systems.
5. Make regions congruent with state political boundaries, each region containing one or more states. This allows a direct compatibility of needed state level data bases and will more easily fit state and federal planning together. It also makes political, economic, and practical sense.

Procedurally, the proposed model works much like the 1980 Assessment and Program is being accomplished. However, there are important differences in concept and detail.

National Forest Lands: Assessment and Program

The numbered steps are matched with Figure 2.

Step 1. Keying from previous programs and monitoring of results, guidelines as to program direction and budgets originate nationally, are regionalized and thence reach the forest. These guidelines essentially define the concept of feasibility to be used at regional and forest levels. This first step is the mechanism by which central management and direction can be given to a strongly decentralized system.

Step 2. The forests use these guidelines to direct the assessment of their resource base. This, of necessity, will have to be done using the current status and condition of the forest data base, regardless of its accuracy and comprehensiveness. If the data base is weak, so will be the assessment. (The ECOSYM/CONGRID information system reviewed later is one such information system that could be used for this purpose.) Each forest then sends up its set of feasible program options to the region where regional goals and constraints are assessed and considered to develop 'feasible' regional options.

Step 3. After reviewing national goals and needs, the National office selects from the aggregated regional options a single package which becomes the recommended current program. Assuming the aggregation of program options relates to actual treatments and acres, after funding

the selected program is disaggregated from region to forest and implemented.

Step 4. The final step in the assessment/program is to monitor and see if the prescribed treatments were actually implemented and what output response was realized. The monitoring function provides data to check and improve predictions of treatment response, and, as the planning feedback to guide the next cycle of assessment and program. Monitoring also gives the handle for legislative oversight which was presumably one purpose of the RPA.

Non-National Forest Lands

Assessment and program development for the private and other public lands follows the same four steps but with the following differences:

1. Assessment and any needed inventories will probably be carried out by the regional office and the state will be the smallest record keeping unit.

2. Assessment itself is more a prediction of what outputs the non-NFS sector is likely to provide in the future rather than identifying feasible options. However, estimates of private response to public policies and programs will still be made.

3. Programs will be the combination of assistance, subsidy and legislation, some of which will be channeled through the State and Private arm of the USFS.

Discussion

The Assessment and Program model outlined above appears to match quite closely the concept of NFS planning as described by the proposed (NFMA) rules developed by Forest Service staff with the suggestion of the committee of scientists. Curiously though, many documents still display an ambiguity as to the relationship of "planning and plans" to "assessment and program." To me they are much the same thing. Assessment is an essential element of planning and the program is the core of the current short term plan. To be sure, a plan will often cover mid- and long-range strategies and cover many details not presented in a program. However, the functional heart of a plan has to be the schedule of actions that will take place prior to next revision and this, along with associated budgeting, is the program of the forest.

It would be helpful to spell out these relationships. Many people inside and outside the USFS view the RPA efforts and the planning efforts as two entirely separate things - somehow budgeting and anticipated on-the-ground activities needed to get together and match up with national statements of agency targets.

Two aspects of this model receive much greater emphasis than the procedures outlined in the RPA progress report: (1) the concept of feasibility and (2) the monitoring function. These seem essential; if projected outputs can't be delivered then credibility is eventually lost. Without monitoring, we'll never learn from experience and have to re-invent the wheel every decade with each new assessment and program.

This isn't to suggest that feasibility and monitoring are ignored. However, the progress report, the 1975 assessment, and the draft planning regulations which I've seen do not adequately face up to these functions.

The next section of this report is a brief critique of the material presented in the Resource Planning Act: A Progress Report.

A CRITIQUE OF THE RPA PROGRESS REPORT

The progress report is encouraging in that it presents a much more coherent description of the assessment and program than previously has been available. My interests are in the process, detail and information system aspects of RPA, however, and very little was presented on these matters. I found the report difficult to evaluate for substance and accuracy. For example we are given no idea as to how or by whom the quantitative targets, presented in graphical form at the end of the report, were derived -- are they 'wish lists' or are they supposed to represent feasible reality? The origin of each graphical cluster is presumably the current level of output; but this is never stated.

The following numbered comments are those that seem important to me. Most are really questions since the available documentation doesn't say or give enough detail to describe what the Forest Service is really doing.

1. It seems that there is still a vagueness in the conceptual definition of Assessment and Program. As handled in 1975 and as presented in the progress report, generation of output options and the issue of feasibility is considered as part of the program. As indicated previously in the model, I can't see how generation of feasible program options can be considered as anything but the central function of assessment. Assessment is an aggregation from the ground up--from forest to national levels--and if the details of program options are not considered in this aggregation then there will never be any guarantee of feasibility. I realize that current data bases make it difficult to work

from the ground up but this is no excuse for not working to establish on-the-ground feasibility.

The necessity of making assessment provide the program options also relates directly to the character of resource information systems. Each forest and region will have different types and conditions of data bases and technology to process data. Furthermore, there is no set of biological common denominators that efficiently describe the resource base nation-wide. The only real common denominator is the results of biological predictions: acres by productivity class or wildlife habitats, current stocks, potential outputs, output responses, etc.

Hence modeling of the bio-physical data base to make predictions of feasible output mixes can only take place locally with any real meaning and effectiveness. Furthermore, if local political, legal, and other practical consideration are considered valid, they can best be dealt with locally.

2. 'Feasibility.' The whole idea is not dealt with realistically, if at all. If 1975 program targets are matched with what has subsequently happened on individual forest or district land use and timber management plans, its questionable that the outputs projected in the 1975 program can be delivered. Unit or local plans for example, typically show timber production going down while national plans show them going up. The projections, in the back of the present progress report look equally ambitious and I question their reality.

Historically, feasibility was not particularly a problem. There were large stocks of timber inventory and a large effective reserve of under-used space. Real outputs were typically much lower than planned levels. Now and moreso in the future, all acres seem to be spoken for and are being

monitored by at least one citizen group. Most of the 'slack' is out of the system and changes in outputs will mean taking acres out of production of one type of outputs (extensive, primitive, recreation and forage, for example) and assigning it to other purposes (i.e., developed, intensive recreation and timber production.)

Since such changes in assignment of acres is likely to receive much public scrutiny, then the actual acres to be re-assigned should at least be checked out on maps and preferably by on-the-ground inspection to see if the re-assignments are really possible. Access, economies of scale and location, environmental impacts and a variety of real consideration arise when actual acres are considered as opposed to categories of acres viewed in tabular summaries.

Feasibility will take on meaning whenever congress and society gets serious about monitoring what is actually happening.

It seems the concept of feasibility -- what constraints are relevant to define feasibility -- should be defined at national levels and disaggregated in the guide or direction process. It will be difficult to agree on what is a legitimate consideration - shall, for example, historical or verbal committments to individuals for, say, forage or recreational use be considered binding in the future?

I think the feasibility issue will come up shortly and the Forest Service had better anticipate how it will be dealt with. As suggested, as the best way would appear to be locally. If the local manager can say "all things considered, I can provide these outputs" we should feel comfortable. If the local data base is scanty, and much information is lacking, their local estimates of output possibilities will likely be modest. Furthermore, if the local manager is held accountable then this too will tend to make estimates realistics.

4. Many of the comments about the 1975 assessment and program were unhappy with the treatment of multiple use interactions. The progress report says the programs will be disaggregated to regional levels, but this isn't far enough. Until assessment and program is disaggregated to the forest and is developed using an in-place information system, interactions simply cannot be adequately considered. The answer is to make integrated forest planning the assessment process and the forest plan and budget the program.

5. The rationale for the different alternative program directions is not at all clear -- why were these five chosen? As best I can tell the five options are distributed as follows by budget level and output emphasis -- the budget index suggests how the four budgets might be ordered, I can't tell from this report which one is right.

	Budget Level			
	Current Program	Proposed 1975 Program	Lower than 1975	Higher than 1975
Possible budget index:	(100)	(120)	(80)	(150)
Relative Output Emphasis:				
Market	#5	A_1	A_2	A_4
Non-Market		#4	A_3	A_5
Both		#3	#2	#1

(Tabled are the five alternative program directions.)

In general we are given only one alternative at each budget level -- thus the choice given is only one of budget level. At the very least we should see the alternatives which are suggested by the letters $A_1, A_2, \ldots$ in the table. This is a persistent problem with USFS plans and alternatives. Additionally, we are told we can have our cake and eat it too (more of both) -- as suggested by directions 1 and 3, which are the ones which will be actively considered. Actually its difficult to envision any alternatives other than #1 being recommended.

As presented, the alternatives are terribly ambiguous. How does "high," "moderate" or "low" output levels compare with current output levels? What rough budget levels are associated with each option?

Its very difficult to relate the charts starting on pp. 45 to these alternatives. Just to make one comparison, if we look at alternative #1, its suggested that we can triple the wilderness acres and double the level of timber sold (charts 4 and 12). How is this possible?

We haven't the faintest idea as to where the charts come from -- the numerical spread suggests a tremendous flexibility in the ability of the National forests to deliver goods and services. I suspect this is more biological capability and hope rather than anything approximating feasible reality (have interactions been worked up?). It may be a mistake to suggest to the American public that all this can be delivered.

5. The relationship of the NFS programs to the outputs which are anticipated on the Non-NFS lands is not specified. Its not even listed as an issue. Are these to be independent programs? Is the NFS supposed to pick up the slack or shortages in the non-NFS? Is the resource capability of the NFS to be used as an instrument of National Economic policy? Is the NFS and the Federal government going to take an active

role in directing production on non-NFS lands? These are important issues which merit direct consideration. In addition, to carry out the NFS assessment and program formulation, some answers are needed.

6. There is still no clearly specified linkage between assessment and program. Putting the two reports under one cover isn't enough, even though it will facilitate comparison. If assessment is conceived of as generating feasible program options then the linkage is clear enough, however, the progress report does not seem to see it this way.

AN EVALUATION OF ECOSYM AS AN INFORMATION MANAGEMENT APPROACH FOR RPA

The objectives of this study have evolved somewhat since its inception. Initially the study was conceived of as one of seven "show-case" or pilot study areas to demonstrate more advanced methods, etc., for developing assessment and program. The subsequent passage of the National Forest Planning Act and the recent proposed rules focusing on an integrated forest plan have suggested a bridging of forest planning with the RPA process.

This present review and evaluation considers ECOSYM/CONGRID with respect to this broader charter.

The specific objectives of this study as stated in the cooperative agreement are:

1. To summarize results of tests of the SEAM/ECOSYM and QRD concepts on the Manti-LaSal working circle and to assess their utility to RPA with particular emphasis on:

   (a) The classification basis for cost-effective multi-resource management information systems;

   (b) Specification of information requirements and allocation of information gathering efforts at national, regional and local levels.

2. To explore the feasibility of using the QRD-ECOSYM concepts and the Manti-LaSal data base as input to FREPAS range evaluation systems, Timber RAM and other LP scheduling (Type I and II model) formulations, Chattachoochee two-stage planning model, and other appropriate analytical

planning models that may be useful in developing priorities for RPA program effort allocation.

3. To investtgate feasibility and outline plans for extending the concepts and doing preliminary quantitative evaluation with the Manti-LaSal data base for using the extended QRD-ECOSYM concepts to:

(a) Provide a framework for multi-resource assessment at local levels;

(b) Serve as a stratification for multi-resource sample surveys;

(c) Provide a framework for monitoring program results;

(d) Explore approaches for quantifying multi-resource interactions;

(e) Demonstrate how the RPA assessment and program concepts may be integrated into the regular information gathering, planning, decision-making, and budgeting procedures at the national forest level.

Procedures

The basic procedures of this evaluation study were threefold:

1. Develop a clear conceptual model of assessment and program and determine what kind of an information system is implied. ECOSYM would then be judged against criteria developed from the model.

2. Have a careful peer review of the concept by capable analysts and systems people familiar with planning, the U. S. Forest Service, and the requirements of the RPA/NFMA legislation. This was done by holding a three-day workshop with five such people in November of 1977.

3. Wait until the ECOSYM project was near completion and judge the apparent acceptability of the resultant information system by forest level people. This would be determined by discussion and feedback after demonstrations of the system.

These three procedural steps have been completed and this report covers the results.

Since the author is also one of the chief architects of the system being evaluated, its a bit like asking the fox to guard the chicken coop. Nevertheless, I hope these results have some value.

ECOSYM/CONGRID/QRD

This section gives a brief description of the ECOSYM idea and how it is designed to work. This description and the appended report is the basis for the evaluation in the following section.

ECOSYM is a comprehensive system for land classification and a framework for building a multi-resource information. The classification and procedural methods along with a description of the case application on the Manti-LaSal National Forest are described in the attached documentation. CONGRID is a conversational grid type computerized data management system which was selected because it is currently operational and is compatible with ECOSYM. Congrid was developed by the University of Georgia, School of Forestry. QRD stands for Questions, Rules, Data and is a characterization of a rational, quantitative management or planning style that can best utilize the ECOSYM/CONGRID type information system. The popular publication in Appendix 2 is the articulation of this concept.

ECOSYM uses a multiple-component approach to classify and describe the land resource base. The components are bedrock, regolith, soils,

topography, climate, current vegetation and potential vegetation. Each component classification is hierarchical in structure and can be objectively measured or mapped. Many economic, physical, and biological interpretations of the land resources can be achieved by explicit analytical or integrative rules which use these components as a common set of independent variables. For example, forage production is calculated from a regression equation using slope, elevation and cover type as explanatory variables. The value of this forage is then calculated with another rule that adds cost and price information.

ECOSYM Design Assumptions and Criteria

From a conceptual and applied analysis of user needs and the functioning of wildland management information systems, we identified several basic assumptions which focused the design and development of ECOSYM and the selection of CONGRID as the computerized data management system.

Assumptions

1. The primary client will be the local land manager and staff.

2. Information needs about wildland resources is varied and diverse; in kinds of users, in kinds of information needed and in the level of accuracy required. The system must have the inherent flexibility to accomodate these diverse needs.

3. That users will know what information they need prior to using the information system; and that the system is not used to provide answers to problems directly but rather to provide objective information to help managers deal with their problems.

4. The classification system will be developed to provide biophysical information.

5. The logic and structure of the classification system needs to be suitable for computer access, storage and retrieval technology. The computerized data or information management can be used for socio-economic information and analysis in addition to biophysical information.

Criteria

In addition to the assumptions which set the general scope and objectives of this effort, several criteriahave been identified which are relevant to evaluation of classification based information systems.

1. The systems have established credibility based on objective empirical testing.

2. The language and logic should be straight forward and understandable by the non-technician.

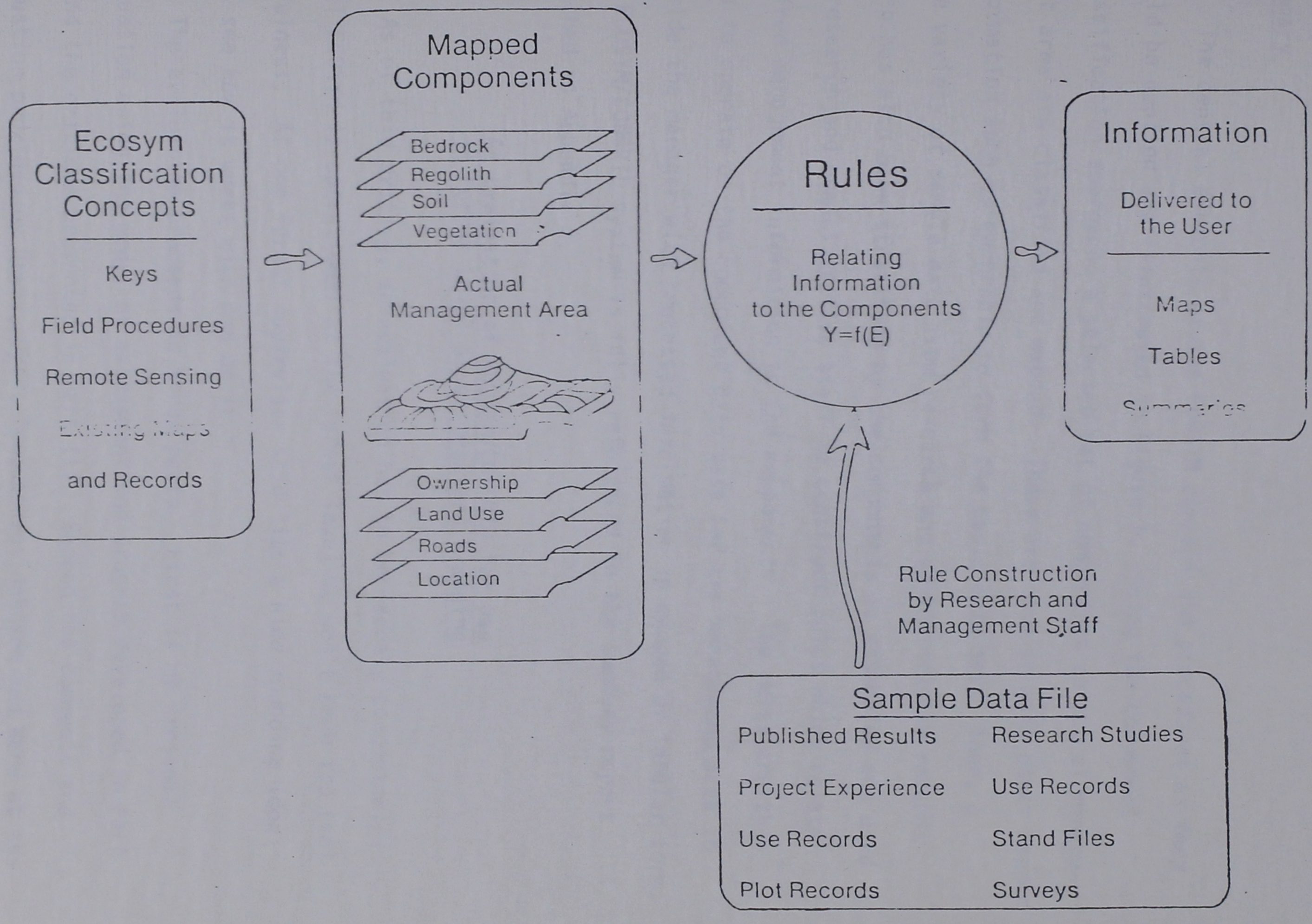
3. It should be effective in terms of providing much of the information needed by managers at a satisfactory level of accuracy.

4. It should be efficient in terms of providing better quantity and/or quality information at the same cost or a given information at lowest cost per unit.

5. The system be understandable and operable by regular professional staff at the local land management level. With nominal training they should be able to identify, classify and map land areas using the classification system and to operate the computerized access storage and retrieval system.

6. The system should be open-ended so that existing data sets, maps, and information can be used initially, and then, with the long-run strategy for the local system defined, an ordered "building block"

Figure 1. The ecosym concept



approach can be taken to fill out the permanent information system.

Summary

The central elements of the ECOSYM concept and procedures as they would be applied are illustrated in Figure 1. Using the component classification approach, a selected set of components on actual management area are classified and mapped. These are coupled with other mapped information such as ownership to form the basic data set. Then, a wide variety of sample data from research and administrative records which has also been stratified by the components is assembled and used by research and administrative staff to construct rules which relate desired management information to the components. The rules are then used to operate on the component data base for the management area to provide the manager with processed information in mapped or tabular form. The ECOSYM/CONGRID system is fully referenced in the summary report attached as Appendix 2.

An Evaluation of ECOSYM/CONGRID for Use in Forest Level Assessment and Planning

As of this writing, an evaluation has to be largely conceptual--until ECOSYM is operational at the forest level we won't know its real usefulness. As one forest supervisor said "its a nice sounding idea, lets see how it works with mud on it."

The evaluation proceeds in three parts. First is my personal evaluation using the model of assessment and program developed in Part II and the critique presented in Part III. Second the comments and evaluation provided by Dress, Dyer, Teeguarden, Johnson and Ware at the workshop held at Snowbird, Utah are presented. Finally the apparent

acceptance of the ECOSYM approach by forest level personnel in several demonstrations and workshops is considered.

Evaluation Against the Model

Regarding information systems, the preceeding assessment and program model concludes that most analysis of resources will take place at the forest or local level and feasibility requires an in-place analysis to link activities with actual acres.

ECOSYM is designed specifically to work at the forest level and initial testing indicates many of the forest level analyses required for assessment can be accomplished. The permanent data base in combination with the rules approach should provide maximum flexibility to deal with the many different outputs and environmental considerations.

CONGRID data handling provides for intersections, computation, acreage summaries and mapping options; all of which are needed by assessment. Future technological development of hardware and software will only improve these capabilities.

The proposed planning regulations specify inventory, monitoring, and information management procedures which are compatible with ECOSYM/CONGRID. Some of the more relevant sections are as follows:

"219.1 - Purpose.

Plans must at least:

(2) Permit upward aggregation of benefits for national and regional estimates of production potentials.

(3) Permit downward disaggregation of that part of demand for forest resource-based benefits that it is national policy to supply from the National Forest System.

(4) Be technically up-to-date in techniques for handling management information (in-place, location-specific data, as well as other data that are not site specific), estimating joint

production potentials by land class and management alternatives, and selecting management strategies that are, in the appropriately specified sense, best or more efficient for meeting goals.

(7) Include full provision for monitoring response of natural resource systems and performance of staff in implementing planned strategies so as to provide the basis for future improvements in plans, decisions and actions.

219.8 - Forest Planning.

(a)3(ii) An assessment must be made of the capability of the land to produce and be used and its suitability for various uses.

(vi) Interactions between various alternative plans and the physical, biological, economic, and social consequences must be evaluated and compared.

(c)(3) Information and data inventories. Forest Service officials shall assure that: (i) methods used to gather data for planning are consistent with those used to monitor consequences of activities resulting from planning; (ii) data are collected and stored for ready retrieval and comparison; (iii) data inventories are compiled only to a degree necessary to meet specific information needs but including sufficient detail for alternative comparison; and (iv) there is an evaluation of accuracy and effectiveness of data.

(4) Assessment of the management situation. There must be a determination of the opportunities or the ability of the lands being assessed to produce and sustain levels of goods, services and uses under resource activities that are physically, biologically, economically, and socially acceptable.

(9) Monitoring. Effects of management activities must be monitored for consistency with standards established in the Forest Plan, as provided in paragraph (g) of this section. The Forest Supervisor shall periodically review the plan and compare monitoring results to standards in the Forest Plan to determine the need for revisions and amendments.

(d) General Planning Requirements. The standards and guidelines contained in this paragraph and those which relate to a resource in section 219.8(e) must be used in the planning process contained in paragraph (c) and must be applied where suitable to the circumstances to be covered by the planning process.

(1) Each Forest Supervisor shall maintain inventories, and develop summaries, maps and descriptions appropriate for making planning and management decisions about the land and resources under his administrative responsibility.

(i) These inventories, summaries, maps and descriptions must include at a minimum:

(A) soil, land and other physical resource surveys, with interpretations for use, such as the capability of soil for growing vegetation and its susceptability to erosion; and also visitor information interpretive opportunities;

(B) natural water occurence (including wetlands), water development and water quality and quantity;

(C) existing vegetation or biotic communities and associated fish and wildlife species; potential natural vegetation according to a recognized regional interpretation of such vegetation and the major successional stages or communities occurring within each area of potential natural vegetation where reasonably possible to determine;

(D) critical habitat of threatened or endangered species, and important habitat for those species which are known or are reasonably expected to occur in such limited habitats or in such low numbers that land management activities might directly or ultimately affect population lefels or are determined to be of significant economic or social importance; and

(E) special conditions and hazards that cause irreversible damage, such as climatic, geologic, and soil hazards, forest fire damage, and major insect and disease problems.

(iii) Methods used to gather data for preparation of the plans and those used to monitor and evaluate consequences of the plan must be consistent. Data must be stored in a manner allowing ready retrieval and continuing use."

ECOSYM/CONGRID can link monitoring to assessment, it deals at least partially with multiple products and interactions and it allows data to be stored allowing for "ready retrieval and continuing use."

ECOSYM/CONGRID can be iniated with nearly any existing data set and provide a rational approach to build in a permanent and more effective information system.

Its important to note that all aggregation of information using the ECOSYM type approach would be by political, administrative or management units. The interdisciplinary, environmental concern and multiple-use interaction aspects of planning and analysis called for by the RPA-NFMA will be provided by the process of planning and the character of the information system, rather than by direct display in written assessment summaries and related documents.

There doesn't appear to be any effective ecological units or biological common denominators to describe the resource base on a regional or national basis. What predicts well or is sensitive to impacts in one area is not in another. Our work suggests it will be much more effective and efficient to have each forest tailor its own data base and assessment uniformity will be found through standard procedures of analysis and summary reports describing feasible output mixes.

Evaluation by the Review Panel (November 1977)

The following are the direct reactions of Dennis Teeguarden, A. Allen Dyer, Peter Dress, Ken Ware and K. Norman Johnson as written on the concluding morning of the workshop. Each had read the attached summary report on ECOSYM and viewed the CONGRID outputs.

I have organized the comments by topics rather than by author. Since all of these people are my personal friends and might be suspected of being charitable, I've decided not to compound the issue by rewriting or paraphrase what they said.

Their comments are grouped in the following order:

1. The concept and structure of ECOSYM/CONGRID.
2. Use of assessment.
3. Trade-off analysis.
4. Forest planning.
5. Specific applications.
6. Limitations.

THE CONCEPT AND STRUCTURE OF ECOSYM/CONGRID

(FIRST RESPONSE)

"Maybe a brief statement of what is implied by a "QRD/ECOSYM/CONGRID type approach would be helpful.

This approach is based on a relatively standard formulation of a management decision problem and the role of information in solving such a problem. That is, at the forest level, management decision problems are specified (objectives set, alternative described, etc.,) and this leads to identification of information that will be needed to rationally choose among alternative management strategies. This, put more in the vernacular language, is "question analysis" or QRD.

The set of questions raised or information needs identified by this process indicates that, common to most of the alternatives specified, there is a need to predict resource system responses to the managerial

strategies (sets of inputs) being considered. And these predictions depend upon the underlying physical and biological character of the site being considered for management treatment, i.e., they depend upon the state of major components of the ecosystem. Hence, there is a need for a rational basis for characterizing or classifying the land according to these components so as to predict responses, in various resource outputs, to various decision levels, degrees of resolution and precision. What is required then is a land classification system by which land may be classified into units which are sufficiently homogeneous in response to management that the whole class may be assumed to give the same output for a given management strategy. Since different outputs (timber, wildlife, water, aesthetics) depend on different components and different levels of resolution, a multi-component hierarchical system is implied. Response relationships or "rules" are then developed to predict outputs on the basis of these ecosystem components. ECOSYM involves just such an approach to land classification as a basis for assessment and management decision.

Now to use such data as are available then from the land classification and the "rules" or response relationships based on them requires some automated data handling capabilities for location-specific or in-place data. CONGRID is such a data handling system based on a grid representation of the map-type data.

What is further implied to complete the application is that there be an analysis system by which to evaluate the economic, environmental, and other anticipated output responses or impacts of each proposed alternative management strategy. These then would permit rational choice among alternatives or "assessment" of alternatives. Programs would then be proposed to implement some of the "best" of these alternatives at different budget levels. These aggregated to national level.

When a national level program is specified it must then be logically disaggregated downward to the specific areas on which the production and management activities are to take place. The QRD/ECOSYM/CONGRID type of system and approahc would then be of assistance to the resources manager in actually scheduling and carrying out the management activities (implementation and control). At the time of the management treatments, data would also be added into the data base showing the costs and other relevant input statistics regarding the treatment. Then after some time, when assessment of results (performance monitoring, attainment reporting) is required, the future data or actual responses would be entered in the data base and provide the basis for modifications in future expectations, assessments, and programs.

In monitoring output responses to management strategies it is necessary to use the same basis of land classification or stratification that was used to predict response and to control the actual imposition of the management treatments. Only in this way can an improvement be made in future predictions and choices among strategies through modification of the rules or treatments to have them correspond with the actual responses realized. And then only by using the same formulation or basis of stratification for the next planning period can we anticipate well what results will then be."

(SECOND RESPONSE)

"A complete management information system considers three categories of information needs:

1. Management input information (input costs, budget and other managerial resource levels, etc.).

2. Resource base information (cover, soils, topography, etc.

3. Treatment specification and output information.

The resource base information system can be further classified as follows:

1. Component information (depth to bedrock, elevation, aspect, etc.)

2. Administrative information (compartment, district, unit boundaries, etc.)

3. Transportation systems information

4. Non-component information (interpretative variables--cover type, condition class, prescriptions, etc.)

ECOSYM is addressed to the resource base information part of an over-all management information system and even more specifically to the component and non-component variable layers. It is clear that assessment must depend on the full range of information but, given the current state of forest management planning, the ECOSYM concept provides a logical starting point for the development of a full, integrated information system. It is imperative for future assessment that the Forest Service begin to develop such systems that are truly operational at the forest level."

(THIRD RESPONSE)

"Given the existing disparity between the way assessment information is developed on the National Forests and what is required in the ECOSYM/CONGRID approach (and the investment required to switch), the system's main use is to set up goals toward which existing land class information systems should move and standards by which they can be judged.

- - the ECOSYM/CONGRID approach embraces four desirable properties for a land classification and information system: 1) basic, permanent components of the land are objectively measured and mapped in-place, 2) a hierarchical structure is available to aggregate the components, 3) production functions (rules) to answer manager's questions are developed using these components, and 4) a computerized data management and mapping system is used to display the mapped data in desired combinations."

USE FOR ASSESSMENT

(FIRST RESPONSE)

<u>As a basis for Assessment and Programming at Forest level</u>

Many critics have suggested that assessments should start with a site-specific data base in order that production functions (rules) can be estimated for reasonably homogeneous areas and to assure that alternative programs can, so to speak, be built from the ground up. ECOSYM provides a system for stratifying a level-base into components that in turn can be used to estimate site-specific production functions. It is the first step in constructing both an assessment and program from the ground up from site-specific information. The test application would certainly seem to suggest that it is technically feasible to design and operate an assessment-programming process that has a site-specific base. At the same time,

we would recognize that the approach will require considerable time and expenditure to implement with the same degree of detail on all forest and range levels."

(SECOND RESPONSE)

"The primary utility of ECOSYM for forest level planning will lie in an improved ability to estimate production potentials which are site specific."

(THIRD RESPONSE)

"It is clear that the possibility would exist to aggregate the output estimates from all forests into a national assessment if an ECOSYM type procedure was operational on each forest. This in turn implies that it would be straight forward to disaggregate the National program back to the Forest level once it had been defined since presumably the production potential estimates would be derived from forest level assessment developed out of an ECOSYM type model. This ability would solve many of the problems associated with the 1st assessment program package."

(FOURTH RESPONSE)

"Under ECOSYM/CONGRID, site specific data are gathered for a grid composed of cells of uniform size. Each cell is independent and stands alone: there is no easy way to consider the cell interaction in the assessment of a resource.

These attributes suggest that ECOSYM/CONGRID is useful chiefly in the assessment of resources that "stay put" like timber and range and some species of wildlife. It would be less useful in the assessment of other resources such as water, wilderness, and recreation, whose qualities depend on interactions between cells."

For general stock taking ECOSYM could improve our estimates of current inventory, current growth, and potential productivity of timber and forage resources and also current inventory and potential productivity for certain wildlife species. It probably would not improve our assessment of the other resource systems of water, wilderness, and recreation."

TRADE OFF ANALYSIS

(FIRST RESPONSE)

"ECOSYM's "rules" provide a means for assessing the capacity of land with specific characteristics to supply certain services, e.g., grazing, timber, wildlife. In its present state of development, it treats each type of service as if it were independent of the others within the various land classes. But given the very large number of classes, it does not seem reasonable to expect that multi-product rules can be developed even for the ease study area.

(SECOND RESPONSE)

"So ECOSYM's usefulness for evaluating trade offs is necessarily limited to quantifying the effects of alternative (budget) level allocations on output combinations for the whole planning unit rather than for identifying feasible combinations of output for specific (land classes) within the unit."

(THIRD RESPONSE)

"Detailed analysis of alternative output potentials on Forest Service land. For a given investment level, ECOSYM/CONGRID could improve our ability to estimate the maximum timber or forage output, and also the maximum output of some wildlife species.

Through enabling an in-place accounting of the impact of a set of planned activities, at a given level of investment, it could enable a more accurate estimate of timber, range, some wildlife outputs produced from these activities. For all the reasons pointed out earlier, it is somewhat less useful in the development of a comprehensive set of response surfaces covering the simultaneous production of all outputs of interest."

FOREST PLANNING

(FIRST RESPONSE)

"Another use which might be made of an ECOSYM type procedure falls into a category which might be termed land classification-allocation or land use gaming. The object of much land management planning as currently carried out is to define dominant use zones based on a combination of of "ecological determinism" logic and political pressure response. The type of planning usually requires production potential information of the type associated with ECOSYM outputs. This is perhaps not a legitimate use of ECOSYM type procedures, but it is a use some would value. The steps would likely involve a trial and error assignment of dominant use type management actions to selected parcels in an attempt to develop a program which achieved previously determined management objectives (output targets)."

(SECOND RESPONSE)

"It gives rise to a land management planning approach in which each unit is managed for some specific dominant use and coincidentally for supplementary and complementary values. However, until it becomes feasible to estimate multi-product production functions for each of the many land classes, we are unable to see that any other approach can be implemented."

SPECIFIC APPLICATION

(FIRST RESPONSE)

"Timber. Timber Harvest Schedule Model (Timber RAM)

The type of information system could be useful in two ways in the development of a timber harvest schedule: 1) creation of inputs and 2) portrayal of the results.

Creation of Inputs. Through stratification of the cells into homogeneous response units, relative to timber production, the existing inventory can be constructed and current growth and future growth can be predicted. When this information is cross-classified with the land use allocation, it could provide needed information about current inventory (acres and volume by species type, land class, condition class) and also the current and future growth rates for a given investment level.

Portrayal of results. In addition to understanding the implications of any harvest schedule on timber harvest over time, it is essential to understand the proposed schedule's impact on other forest outputs of interest. With the renewed committment from the National Forest Management Act to the sustained production of all outputs of interest, and the setting of program goals for some of these outputs, it is essential to understand the impact of harvest schedule's impact on them. Through ECOSYM/CONGRID's ability to estimate harvest schedule impacts over time and location of the harvest on the ground, the approach could prove helpful in portraying the temporal-spatial implications of a particular harvest schedule.

Suppose that wildlife considerations make it important to not cut adjacent stands within 10 years of each other. Through developing a

tentative harvest schedule and viewing the harvest pattern over time, it should be possible to assess whether this constraint is met, and if it isn't, resolve the timber scheduling problem with a new set of constraints, check again, and continue this procedure until a feasible solution is found.[1] Then, using the rules developed from ECOSYM, actual wildlife production from decade to decade could be found.

All-in-all, the ECOSYM/CONGRID approach could provide a mechanism to improve our ability to develop timber harvest schedules and documents the implications of their use."

PRODUCTION MODELS

(FIRST RESPONSE)

"The ECOSYM model could also be a partial source of production coefficients for the mathematical programming models being used to develop forest, unit and functional plans. By specifying the level of management intensity, one variable in the "rule", the model should predict some of the output responses for the proposed action. This of course assumes that the "rules" have to be constructed so as to be sensitive to management intensity by category of management action."

ECONOMIC IMPACT

(FIRST RESPONSE)

"Similarly, the output vector from a unit could be translated into a direct economic activity estimate by application of á $ output/output volume technique. This in turn could be the data input into a regional economic-population-infrastructure model. It is important to note that the geo-

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'Because the stands from different locations are grouped in development of the basic inventory (timber classes) it is difficult to apply these spatial constraints directly.

(FIRST RESPONSE)

ECONOMIC IMPACT

(FIRST RESPONSE)

PRODUCTION MODELS

graphic space the regional economic impacts are identified with would not normally be coincident with the forest geographic space. This is not a particular problem, it only suggests that the regional economic and social consequences of actions flow across Forest Boundaries."

LIMITATIONS

(FIRST RESPONSE)

"To be sure, ECOSYM deals primarily with only one apsect (the bio-physical) of a complete forest management information system."

(SECOND RESPONSE)

"A firm recommendation for how to utilize the ECOSYM/CONGRID approach in the assessment must await a comprehensive test in which it is applied to an entire national forest."

(THIRD RESPONSE)

"The drawbacks to an ECOSYM type approach to assessment that appears most serious are:

1. The costs of implementing the system,
2. The availability of skilled manpower within the Forest Service,
3. Knowledge gaps about the appropriate rules."

(FOURTH RESPONSE)

"I view movement toward these properties (of the ECOSYM concept) by the many different land classification and information systems now in use, as desirable as 1) long as it is cost-effective, and 2) it does not result in the sacrifice of even more important information currently being provided by existing systems."

SUMMARY

To summarize, as best I can tell, the group seemed to feel ECOSYM/CONGRID has the potential to be an effective system and would work fairly well with in-place analysis and assessment of resources that stayed put (such as timber). ECOSYM/CONGRID was compatible with the enhanced rational planning approaches. ECOSYM had some real limitation in its ability to deal with multiple-output trade-off analysis. It could, however, give some handles on this through in-place visual analysis and overlaying of proposed allocations and treatments using the mapping outputs.

The system should be a good technique to generate input data, such as acreage within different response strata, to implement various analytical models such as a linear program. Final judgement must wait for an operational, full scale testing on a few national forests. This would determine practical applicability and effective cost.

In balance, the system appears promising for some important assessment and planning purposes - the next step is to give it a real test.

Evaluation by National Forest Personnel

We have presented the ECOSYM/CONGRID approach to national forest personnel on three separate occasions

March 23, 24, 25 - A detailed training session for 8 technical people (planning and systems specialists) from the R-4 office, Manti LaSal, Uinta and Custer National Forests. The objective was a detailed review of concepts, hands-on experience at using CONGRID, and developing strategy for application on the student's forests.